FORMULAS AND OXIDATION NUMBERS

A chemical formula is a combination of symbols and numerical subscripts that represents the composition of a compound. The symbols indicate which elements are present and the numerical subscripts indicate the relative proportion of each element in the compound. These proportions can be predicted using the oxidation numbers of the elements and the charges of polyatomic ions. When atoms acquire a charge they are called ions. Ions consisting of more than one atom are polyatomic ions. Its oxidation number represents the apparent charge on an atom.

It is important that all scientists use the same system for writing chemical formulas. This helps to ensure clear and consistent transmission of information. Therefore, the following rules should be used for writing chemical formulas.

1. **In a neutral compound the sum of the oxidation numbers of the elements and the charges on polyatomic ions in that compound must equal zero.**
2. **One positive (+) charge will neutralize one negative (-) charge.**
3. **Atoms with positive oxidation numbers or ions with positive charges are written first.**
4. **When the relative proportion of an element in a compound is greater than one, the symbol for that element must be followed by a numerical subscript indicating its relative proportion, as in $MgCl_2$**
5. **When the relative proportion of a polyatomic ion in a compound is greater than one, the symbol for the polyatomic ion must be enclosed by parentheses, followed by the correct numerical subscript, as in $AI_2(SO_4)_3$.**

In this experiment you will use cut-out models of ions to form neutral compounds. The correct chemical formula and name for each compound will be determined by balancing oxidation numbers and charges.

OBJECTIVES

In this experiment, you will:

- cut out models of ions
- match the necessary number of ions until the positive and negative oxidation numbers equal 0
- predict the correct formulas for the compounds listed.

EQUIPMENT

scissors
pencil and paper
sheet of ion models
glue stick

PROCEDURE

1. Prepare a data table as directed in the Analysis.
2. Cut out each of the "ion" squares from the sheet provided by your teacher.
3. Construct formulas for the following combinations of substances. For example, the formula for a compound containing magnesium and chlorine may be determined in the following way. Place the Mg2+ ion on a piece of paper. Place enough CI- ions alongside the Mg2 + ion to balance the charges. (Positive charges must equal negative charges.)
4. Predict formulas for four additional compounds using the ions listed in this experiment. (see data table for requirements). Use references to determine if your compounds exist.

Combining Substances:
aluminum and bromine
sodium and oxygen
iron(II) and sulfur
aluminum and nitrate ion
potassium and sulfate ion
iron(III) and chlorine
ammonium ion and sulfur
aluminum and oxygen
iron(lII) and sulfate ion
sodium and phosphate ion

ANALYSIS

Use the table provided for your data. Be sure to use enough glue so that the ions do not fall off the chart. Use the rules listed in your textbook for writing formulas and naming compounds.

CONCLUSIONS

1. Some compounds are described as binary compounds. What does this term mean? What ending is given to the name of this type of compound? Refer to your data table and list the formulas for any binary compounds you have constructed.

2. Most polyatomic ions end in -ate or -ite. Name at least two which end in -ide. (Look in your notes from class or your textbook)

3. Hydrogen peroxide (H_2O_2) and water (H_2O) both contain the same two elements. Using reference materials, describe their properties and uses. Use the information on hydrogen peroxide and water, and the data from this experiment to discuss the importance of writing correct chemical formulas.

Name: ______________________________________ Date: ____________ Class: _________________

Ion Cut-out Data Table

Combining Ions	Chemical Formula	Name of Compound
Example: $[K^{+}][NO_3^{-1}]$	KNO_3	Potassium Nitrate

Name: _______________________________________ Date: ____________ Class: _________________

Combining Ions	**Chemical Formula**	**Name of Compound**
Transition metal + Polyatomic anion		
Transition metal + Anion from family 15, 16, or 17		
Cation from family 1, 2, or 13 + Polyatomic anion		
Cation in family 1, 2, 13 + Anion in family 15, 16, or 17		

Conclusion Q 1:

Conclusion Q 2:

Conclusion Q 3:

CATIONS: Print on YELLOW paper

Fe^{+3}	Fe^{+3}	Fe^{+3}	Fe^{+3}	Fe^{+3}
Fe^{+2}	Fe^{+2}	Fe^{+2}	Fe^{+2}	Fe^{+2}
Na^{+1}	Na^{+1}	Na^{+1}	Na^{+1}	Na^{+1}
Mg^{+2}	Mg^{+2}	Mg^{+2}	Mg^{+2}	Mg^{+2}
K^{+1}	K^{+1}	K^{+1}	K^{+1}	K^{+1}
NH_4^{+1}	NH_4^{+1}	NH_4^{+1}	Al^{+3}	Al^{+3}
Al^{+3}	Li^{+1}	Li^{+1}	Li^{+1}	Li^{+1}
Zn^{+2}	Zn^{+2}	Zn^{+2}	Ca^{+2}	Ca^{+2}
Ca^{+2}	Al^{+3}	Cu^{+2}	Cu^{+2}	Cu^{+2}
Al^{+3}				

ANIONS: Print on BLUE Paper

S^{-2}	S^{-2}	S^{-2}	S^{-2}	S^{-2}
O^{-2}	O^{-2}	O^{-2}	O^{-2}	O^{-2}
Cl^{-1}	Cl^{-1}	Cl^{-1}	Cl^{-1}	Cl^{-1}
Br^{-1}	Br^{-1}	Br^{-1}	Br^{-1}	Br^{-1}
NO_3^{-1}	NO_3^{-1}	NO_3^{-1}	NO_3^{-1}	NO_3^{-1}
SO_4^{-2}	SO_4^{-2}	SO_4^{-2}	SO_4^{-2}	SO_4^{-2}
PO_4^{-3}	PO_4^{-3}	PO_4^{-3}	PO_4^{-3}	PO_4^{-3}
I^{-1}	I^{-1}	I^{-1}	I^{-1}	I^{-1}
P^{-3}	P^{-3}	P^{-3}	P^{-3}	P^{-3}